

ROUND 13

TOSS-UP

1) CHEMISTRY *Short Answer* What is the van 't Hoff factor for glucose?

ANSWER: 1

BONUS

1) CHEMISTRY *Short Answer* What color of flame does lithium produce in a flame test?

ANSWER: RED

TOSS-UP

2) EARTH AND SPACE *Short Answer* What is the name for a spherical collection of stars that orbits a galactic core as a satellite?

ANSWER: GLOBULAR CLUSTER

BONUS

2) EARTH AND SPACE *Short Answer* What method of distance estimation, used for relatively close stars, involves telescope observations at 6-month intervals?

ANSWER: PARALLAX TECHNIQUE (ACCEPT: PARALLAX, STELLAR PARALLAX)

TOSS-UP

3) BIOLOGY *Multiple Choice* Which period involved a major extinction event that included the dinosaurs?

- W) Between the Paleozoic and Mesozoic eras
- X) Between the Phanerozoic and the Precambrian eras
- Y) Between the Mesozoic and Cenozoic eras
- Z) Between the Precambrian and Paleozoic eras

ANSWER: Y) BETWEEN THE MESOZOIC AND CENOZOIC ERAS

BONUS

3) BIOLOGY *Multiple Choice* If a 24 hour clock was made to model the major events of the evolution of life on Earth, humans would appear:

- W) Close to the beginning of the 24 hour period
- X) About 12 hours through the 24 hour period
- Y) About 2 hours before the 24 hours were up
- Z) Less than a minute before the 24 hours were up

ANSWER: Z) LESS THAN A MINUTE BEFORE THE 24 HOURS WERE UP

TOSS-UP

4) PHYSICS *Multiple Choice* Which of the following does a Carnot engine convert?

- W) Energy to heat
- X) Pressure to volume
- Y) Heat to work
- Z) Work to pressure

ANSWER: Y) HEAT TO WORK

BONUS

4) PHYSICS *Short Answer* A heat engine operates with 60 kilocalories of heat supplied, and exhausts 40 kilocalories of heat. How much work, in joules, did the engine do? Provide your answer to the nearest thousand.

ANSWER: 84,000

TOSS-UP

5) BIOLOGY *Multiple Choice* Flowers are actually miniature stems that produce four kinds of specialized:

- W) Roots
- X) Leaves
- Y) Vascular tissue
- Z) Cones

ANSWER: X) LEAVES

BONUS

5) BIOLOGY *Multiple Choice* Which of the following is a characteristic of old growth forests?

- W) Soil profiles have well-defined horizons
- X) All trees are roughly the same age
- Y) Sunlight is uniformly distributed
- Z) Ground cover is low in organic matter

ANSWER: W) SOIL PROFILES HAVE WELL-DEFINED HORIZONS

TOSS-UP

6) PHYSICS *Short Answer* Careful measurements have shown that the mass of a particular atom is always slightly less than the sum of the masses of the individual neutrons, protons, and electrons of which the atom consists. What is the difference between the mass of the atom and the sum of the masses of its parts called?

ANSWER: MASS DEFECT

BONUS

6) PHYSICS *Short Answer* A 62 kilogram boy on a 1.50 kilogram skateboard moving at 1.2 meters per second steps off and lands on the sidewalk with a velocity of 1.1 meters per second. Providing your answer as a decimal rounded to the nearest tenth, how fast is the skateboard moving in meters per second?

ANSWER: 5.3

TOSS-UP

7) EARTH AND SPACE *Short Answer* If Saturn is approximately 10 times further from the Sun than Earth, what is the ratio of the intensity of solar radiation it receives relative to Earth? Provide your answer in lowest terms.

ANSWER: 1/100

BONUS

7) EARTH AND SPACE *Multiple Choice* If Earth's axial tilt was 28° in the opposite direction, which of the following would be true?

- W) There would be more extreme seasonal variations
- X) The eastern and western hemispheres' seasons would reverse
- Y) Plate tectonics would halt
- Z) Tides would reverse their patterns

ANSWER: W) THERE WOULD BE MORE EXTREME SEASONAL VARIATIONS

TOSS-UP

8) MATH *Multiple Choice* Which of the following numbers is not prime?

- W) 137
- X) 143
- Y) 167
- Z) 229

ANSWER: X) 143

BONUS

8) MATH *Short Answer* If a random number R is a real number from the closed interval $[0, 1]$, then how many possible integer values could be generated by the expression $12R + 7$?

ANSWER: 13

TOSS-UP

9) BIOLOGY *Short Answer* What are the most abundant cells in bones?

ANSWER: OSTEOCYTES (read as: OHS-tee-oh-syts)

BONUS

9) BIOLOGY *Short Answer* Name all of the following that are NOT located in the cortex of the mammalian kidney: 1) Glomeruli and Bowman's capsules, 2) collecting ducts, and 3) proximal convoluted tubules.

ANSWER: 2) COLLECTING DUCTS

TOSS-UP

10) CHEMISTRY *Short Answer* What is the formula for sulfurous acid?

ANSWER: H_2SO_3

BONUS

10) CHEMISTRY *Multiple Choice* Which of the following is the strongest acid?

W) HCl

X) HBr

Y) HI (read as: H eye)

Z) HNO_3

ANSWER: Y) HI

TOSS-UP

11) PHYSICS *Multiple Choice* Which of the following explains why extremely high energy is needed for fusion to work?

- W) To break the nuclei into two parts
- X) To bind the protons and electrons
- Y) To overcome the electrical repulsion between two positively charged nuclei
- Z) To create the necessary supercold environment

ANSWER: Y) TO OVERCOME THE ELECTRICAL REPULSION BETWEEN TWO POSITIVELY CHARGED NUCLEI

BONUS

11) PHYSICS *Multiple Choice* The temperature in the region of the Sun where fusion occurs is about how many degrees Fahrenheit?

- W) 1,000
- X) 50,000
- Y) 7,800,000
- Z) 27,000,000

ANSWER: Z) 27,000,000

TOSS-UP

12) CHEMISTRY *Multiple Choice* Which of the following chemical bonds is not important in polymer formation?

- W) Glycosidic (read as: gly-koh-SYDIK)
- X) Hydrogen
- Y) Peptide
- Z) Phosphodiester (read as: FOHS-foh-DY-ehs-tehr)

ANSWER: X) HYDROGEN

BONUS

12) CHEMISTRY *Short Answer* What relationship exists between bond length and bond order?

ANSWER: INVERSE RELATIONSHIP (ACCEPT: BONDS OF HIGHER ORDER ARE SHORTER IN LENGTH)

TOSS-UP

13) MATH *Multiple Choice* Which of the following radical expressions is in simplest form?

W) $\frac{\sqrt{31}}{3}$ (read as: the square root of 31 over 3)

X) $-5\sqrt{175}$ (read as: negative 5 times the square root of 175)

Y) $6\sqrt{\frac{x^2}{4}}$ (read as: 6 times the square root of the quantity x squared over 4)

Z) $-\sqrt{153x}$ (read as: the negative square root of 153 x)

ANSWER: W) $\frac{\sqrt{31}}{3}$

BONUS

13) MATH *Short Answer* If x is negative, simplify $7\sqrt{5x} \times \sqrt{180x^5}$ (read as: 7 times the square root of 5x times the square root of, open parenthesis, 180x to the fifth, close parenthesis)

ANSWER: $-210x^3$

TOSS-UP

14) ENERGY *Short Answer* What is the term used to describe the total amount of energy used in the production of a product, including raw material extraction, manufacture, transportation, assembly, and all other aspects of production?

ANSWER: EMBODIED ENERGY

BONUS

14) ENERGY *Multiple Choice* In 2009, demand for small wind systems for residential and small business use grew 15%, adding 20 megawatts of wind-generating capacity. What was the approximate capacity of small wind systems in 2008 in megawatts?

W) 17

X) 35

Y) 115

Z) 133

ANSWER: Z) 133

TOSS-UP

15) EARTH AND SPACE *Multiple Choice* Which of the following is NOT a metamorphic rock?

- W) Schist (read as: SHIST)
- X) Gneiss (read as: NYS)
- Y) Basalt
- Z) Marble

ANSWER: Y) BASALT

BONUS

15) EARTH AND SPACE *Multiple Choice* Which of these is NOT true about ultramafic rock?

- W) The Earth's mantle is composed of ultramafic rock
- X) Ultramafic rocks are usually dark colored
- Y) Ultramafic rock crystallizes at higher temperatures than felsic rock
- Z) Andesite is a type of ultramafic rock

ANSWER: Z) ANDESITE IS A TYPE OF ULTRAMAFIC ROCK

TOSS-UP

16) PHYSICS *Multiple Choice* An electron-volt is the:

- W) Energy gained by 1 electron falling through a 1 meter vertical distance
- X) Energy of a visible light photon
- Y) Energy of 1 electron accelerated through a 1 volt potential difference
- Z) Energy of a typical electron orbiting a nucleus

ANSWER: Y) ENERGY OF 1 ELECTRON ACCELERATED THROUGH A 1 VOLT POTENTIAL DIFFERENCE

BONUS

16) PHYSICS *Short Answer* What is the world's largest and highest energy particle accelerator, designed to collide proton beams at 7 teraelectron volts?

ANSWER: LARGE HADRON COLLIDER

TOSS-UP

17) ENERGY *Short Answer* During oxidative phosphorylation, the proton gradient is used to drive which enzyme?

ANSWER: ATP SYNTHASE

BONUS

17) ENERGY *Multiple Choice* What is the approximate Gibbs free energy change per mole associated with oxidation of glucose?

- W) -3000 kilojoules
- X) -3000 joules
- Y) 3000 joules
- Z) 3000 kilojoules

ANSWER: W) -3000 KILOJOULES

TOSS-UP

18) MATH *Short Answer* What are the x-intercepts of $y = x^2 - 15x + 54$?

ANSWER: 6 AND 9

BONUS

18) MATH *Multiple Choice* Which of the following equations does not have real solutions?

- W) $-3x^2 + 3 = 0$
- X) $x^2 - 5x + 2 = 0$
- Y) $4x^2 - 3x - 0.25 = 0$
- Z) $x^2 - x + 1 = 0$

ANSWER: Z) $x^2 - x + 1 = 0$

TOSS-UP

19) ENERGY *Short Answer* An engine yields 100 watts of power for every 1000 watts received. What is the efficiency of the engine?

ANSWER: 10%

BONUS

19) ENERGY *Short Answer* Using 750 watts per horsepower, if a 120 horsepower engine ran for 10 hours, how much energy, in kilowatt hours, would it consume? Provide your answer to the nearest integer.

ANSWER: 900

TOSS-UP

20) EARTH AND SPACE *Short Answer* Which of the following molecules is NOT known to destroy ozone molecules in our stratosphere?

- W) Chlorofluorocarbons
- X) Chlorine
- Y) Bromine
- Z) Argon

ANSWER: Z) ARGON

BONUS

20) EARTH AND SPACE *Multiple Choice* In which of the following months is the Antarctic ozone hole the largest?

- W) January
- X) April
- Y) July
- Z) September

ANSWER: Z) SEPTEMBER

TOSS-UP

21) BIOLOGY *Multiple Choice* Which of the following is NOT an example of the negative effects of bioaccumulation of toxins in the environment?

- W) The thinning of bird eggshells due to DDT
- X) Inedibility of oysters due to their filter feeding on naturally occurring red tide algae
- Y) Birth defects in babies exposed to Accutane in utero
- Z) Inedibility of fish due to mercury content

ANSWER: Y) BIRTH DEFECTS IN BABIES EXPOSED TO ACCUTANE IN UTERO

BONUS

21) BIOLOGY *Multiple Choice* If a deer population exceeds its carrying capacity, which of the following will likely happen?

- W) The birth rate will increase
- X) The death rate will increase
- Y) The death rate will decrease
- Z) Carrying capacity will increase

ANSWER: X) THE DEATH RATE WILL INCREASE

TOSS-UP

22) MATH *Short Answer* What is the reference angle for $\frac{7\pi}{6}$?

ANSWER: $\frac{\pi}{6}$

BONUS

22) MATH *Short Answer* Given coordinates A (1,2), B (7,1), C (3,0), and D (4,6), find the angle in degrees between \overrightarrow{AB} and \overrightarrow{CD} .

ANSWER: 90°

TOSS-UP

23) EARTH AND SPACE *Multiple Choice* Flood basalts, such as the Cretaceous Deccan Traps in Siberia, may have had a major impact on which of the following past events?

- W) Climate change
- X) Formation of island arcs
- Y) Human development
- Z) Interruption in stratospheric circulation

ANSWER: W) CLIMATE CHANGE

BONUS

23) EARTH AND SPACE *Short Answer* The Deccan traps of 66 million years ago may have influenced Earth's climate through the release of which sulfur species common to volcanic gases?

ANSWER: SULFUR DIOXIDE

TOSS-UP

24) MATH *Short Answer* What is the smallest integer greater than 1 that is relatively prime with 210?

ANSWER: 11

BONUS

24) MATH *Multiple Choice* Which of the following numbers is not a Mersenne prime?

- W) 7
- X) 31
- Y) 61
- Z) 127

ANSWER: Y) 61

TOSS-UP

25) CHEMISTRY *Multiple Choice* Which of the following 1.0 molar solutions will have the highest pH?

- W) Hydrochloric acid
- X) Nitrous acid
- Y) Sulfuric acid
- Z) Hydrobromic acid

ANSWER: X) NITROUS ACID

BONUS

25) CHEMISTRY *Multiple Choice* 10 milliliters of a 0.1 molar solution of which of the following substances added to 10 milliliters of a 0.1 molar acetic acid solution will form a buffer solution?

- W) Hydrochloric acid
- X) Sodium chloride
- Y) Sodium hydroxide
- Z) Potassium acetate (read as: AH-seh-tayt)

ANSWER: Z) POTASSIUM ACETATE